

# STARPOWER

SEMICONDUCTOR

**IGBT**

## GD300MPY120C6S

**1200V/300A 2 in one-package**

### General Description

STARPOWER IGBT Power Module provides ultra low conduction loss as well as short circuit ruggedness. They are designed for the applications such as 3-level-applications.

### Features

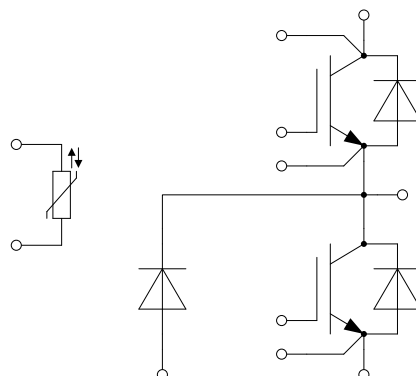
- Low  $V_{CE(sat)}$  Trench IGBT technology
- 10 $\mu$ s short circuit capability
- $V_{CE(sat)}$  with positive temperature coefficient
- Maximum junction temperature 175°C
- Low inductance case
- Fast & soft reverse recovery anti-parallel FWD
- Isolated copper baseplate using DBC technology



### Typical Applications

- Solar power
- UPS
- 3-level-applications

### Equivalent Circuit Schematic



**Absolute Maximum Ratings**  $T_C=25^{\circ}\text{C}$  unless otherwise noted**IGBT-inverter**

Symbol	Description	Value	Unit
$V_{CES}$	Collector-Emitter Voltage	1200	V
$V_{GES}$	Gate-Emitter Voltage	$\pm 20$	V
$I_C$	Collector Current @ $T_C=25^{\circ}\text{C}$	480	A
	@ $T_C=100^{\circ}\text{C}$	300	A
$I_{CM}$	Pulsed Collector Current $t_p=1\text{ms}$	600	A
$P_D$	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	1613	W

**Diode-inverter**

Symbol	Description	Value	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	1200	V
$I_F$	Diode Continuous Forward Current	300	A
$I_{FM}$	Diode Maximum Forward Current $t_p=1\text{ms}$	600	A

**Diode-3-level**

Symbol	Description	Value	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	1200	V
$I_F$	Diode Continuous Forward Current	300	A
$I_{FM}$	Diode Maximum Forward Current $t_p=1\text{ms}$	600	A

**Module**

Symbol	Description	Value	Unit
$T_{jmax}$	Maximum Junction Temperature	175	$^{\circ}\text{C}$
$T_{jop}$	Operating Junction Temperature	-40 to +150	$^{\circ}\text{C}$
$T_{STG}$	Storage Temperature Range	-40 to +125	$^{\circ}\text{C}$
$V_{ISO}$	Isolation Voltage RMS, $f=50\text{Hz}$ , $t=1\text{min}$	2500	V

**IGBT-inverter Characteristics**  $T_C=25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C=300\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.70	2.15	V
		$I_C=300\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		1.95		
		$I_C=300\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		2.00		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=7.50\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	5.2	6.0	6.8	V
$I_{CES}$	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$			1.0	mA
$I_{GES}$	Gate-Emitter Leakage Current	$V_{GE}=V_{GES}, V_{CE}=0\text{V}, T_j=25^\circ\text{C}$			400	nA
$R_{Gint}$	Internal Gate Resistance			2.5		$\Omega$
$C_{ies}$	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		21.0		nF
$C_{res}$	Reverse Transfer Capacitance				1.20	
$Q_G$	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		2.60		$\mu\text{C}$
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=300\text{A}, R_G=1.5\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		313		ns
$t_r$	Rise Time			57		ns
$t_{d(off)}$	Turn-Off Delay Time			464		ns
$t_f$	Fall Time			206		ns
$E_{on}$	Turn-On Switching Loss			9.97		mJ
$E_{off}$	Turn-Off Switching Loss			28.6		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=300\text{A}, R_G=1.5\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		336		ns
$t_r$	Rise Time			66		ns
$t_{d(off)}$	Turn-Off Delay Time			528		ns
$t_f$	Fall Time			299		ns
$E_{on}$	Turn-On Switching Loss			21.1		mJ
$E_{off}$	Turn-Off Switching Loss			36.6		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=300\text{A}, R_G=1.5\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$		345		ns
$t_r$	Rise Time			68		ns
$t_{d(off)}$	Turn-Off Delay Time			539		ns
$t_f$	Fall Time			309		ns
$E_{on}$	Turn-On Switching Loss			25.6		mJ
$E_{off}$	Turn-Off Switching Loss			37.8		mJ
$I_{SC}$	SC Data	$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=900\text{V}, V_{CEM} \leq 1200\text{V}$		1200		A

**Diode-inverter Characteristics**  $T_C=25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_F$	Diode Forward Voltage	$I_F=300\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.90	2.35	V
		$I_F=300\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.90		
		$I_F=300\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.90		
$Q_r$	Recovered Charge	$V_{CC}=600\text{V}, I_F=300\text{A},$ $-di/dt=6050\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $T_j=25^\circ\text{C}$		15.5		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			223		A
$E_{rec}$	Reverse Recovery Energy			8.0		mJ
$Q_r$	Recovered Charge	$V_{CC}=600\text{V}, I_F=300\text{A},$ $-di/dt=6050\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $T_j=125^\circ\text{C}$		31.5		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			290		A
$E_{rec}$	Reverse Recovery Energy			13.6		mJ
$Q_r$	Recovered Charge	$V_{CC}=600\text{V}, I_F=300\text{A},$ $-di/dt=6050\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $T_j=150^\circ\text{C}$		41.2		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			305		A
$E_{rec}$	Reverse Recovery Energy			17.2		mJ

**Diode-3-level Characteristics**  $T_C=25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_F$	Diode Forward Voltage	$I_F=300\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.90	2.35	V
		$I_F=300\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.90		
		$I_F=300\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.90		
$Q_r$	Recovered Charge	$V_{CC}=600\text{V}, I_F=300\text{A},$ $-di/dt=6050\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $T_j=25^\circ\text{C}$		15.5		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			223		A
$E_{rec}$	Reverse Recovery Energy			8.0		mJ
$Q_r$	Recovered Charge	$V_{CC}=600\text{V}, I_F=300\text{A},$ $-di/dt=6050\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $T_j=125^\circ\text{C}$		31.5		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			290		A
$E_{rec}$	Reverse Recovery Energy			13.6		mJ
$Q_r$	Recovered Charge	$V_{CC}=600\text{V}, I_F=300\text{A},$ $-di/dt=6050\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $T_j=150^\circ\text{C}$		41.2		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			305		A
$E_{rec}$	Reverse Recovery Energy			17.2		mJ

**NTC Characteristics**  $T_C=25^{\circ}\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$R_{25}$	Rated Resistance			5.0		$\text{k}\Omega$
$\Delta R/R$	Deviation of $R_{100}$	$T_C=100^{\circ}\text{C}, R_{100}=493.3\Omega$	-5		5	%
$P_{25}$	Power Dissipation				20.0	mW
$B_{25/50}$	B-value	$R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15\text{K}))]$		3375		K

**Module Characteristics**  $T_C=25^{\circ}\text{C}$  unless otherwise noted

Symbol	Parameter	Min.	Typ.	Max.	Unit
$L_{CE}$	Stray Inductance		35		nH
$R_{CC'+EE'}$	Module Lead Resistance, Terminal to Chip		1.45		$\text{m}\Omega$
$R_{thJC}$	Junction-to-Case (per IGBT-inverter)			0.093	K/W
	Junction-to-Case (per Diode-inverter)			0.135	
	Junction-to-Case (per Diode-3-level)			0.135	
$R_{thCH}$	Case-to-Sink (per IGBT-inverter)		0.037		K/W
	Case-to-Sink (per Diode-inverter)		0.053		
	Case-to-Sink (per Diode-3-level)		0.053		
	Case-to-Heatsink (per Module)		0.009		
M	Terminal Connection Torque, Screw M6	3.0		6.0	N.m
	Mounting Torque, Screw M5	3.0		6.0	
G	Weight of Module		350		g

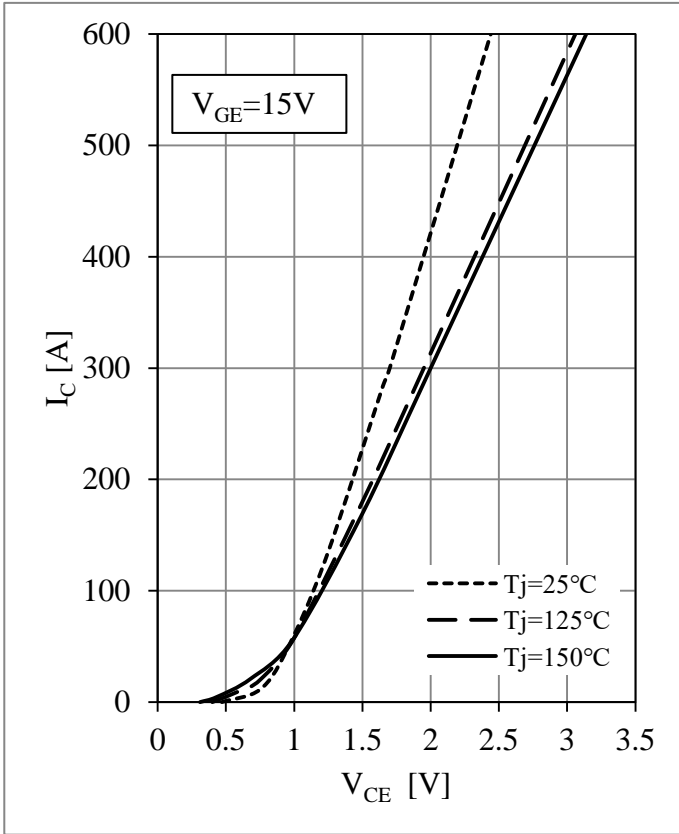


Fig 1. IGBT-inverter Output Characteristics

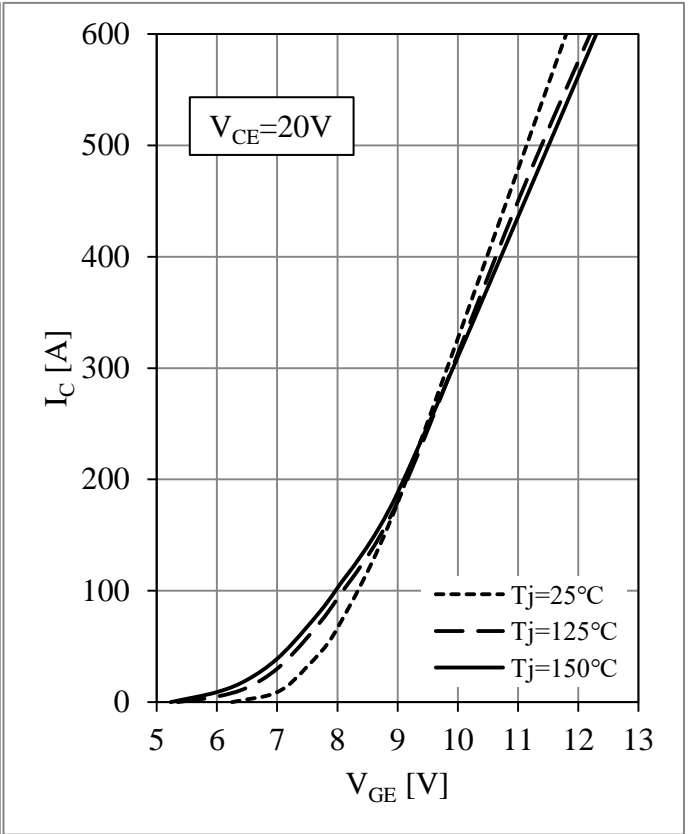


Fig 2. IGBT-inverter Transfer Characteristics

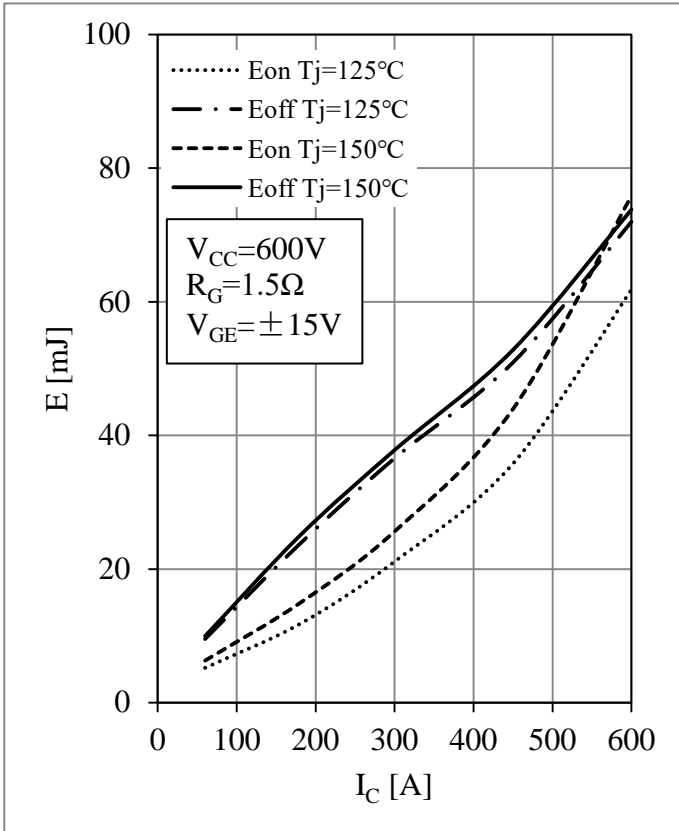


Fig 3. IGBT-inverter Switching Loss vs.  $I_C$

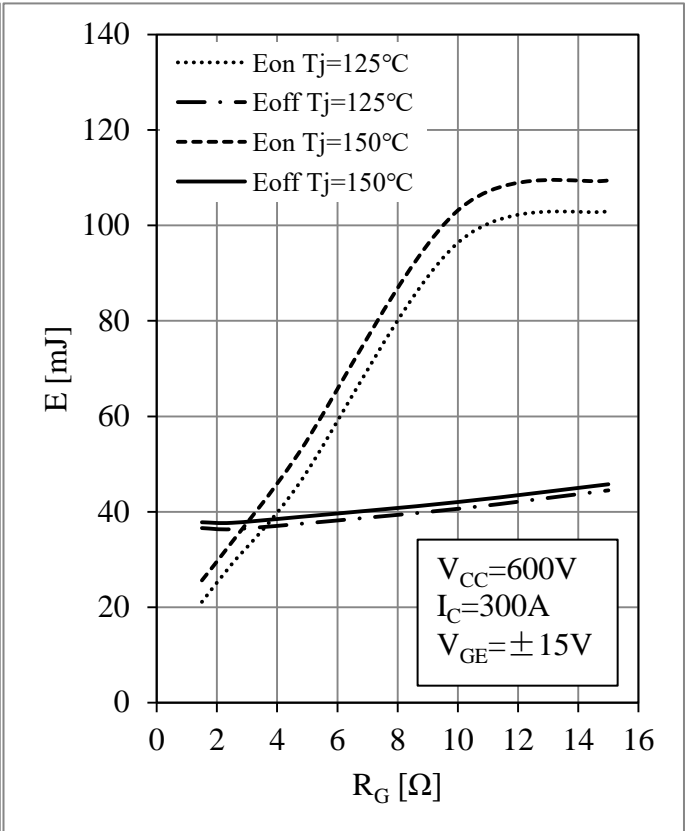


Fig 4. IGBT-inverter Switching Loss vs.  $R_G$

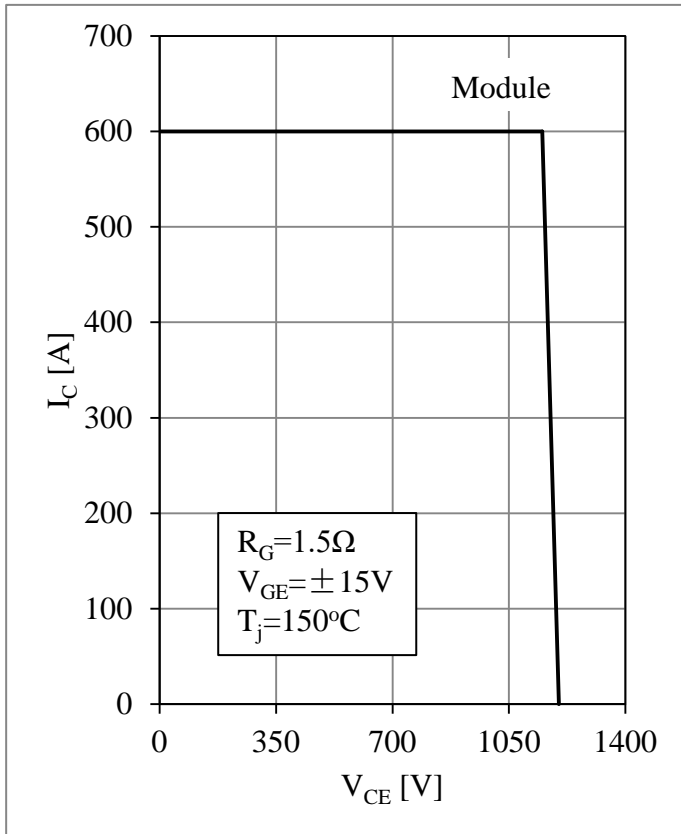


Fig 5. IGBT-inverter RBSOA

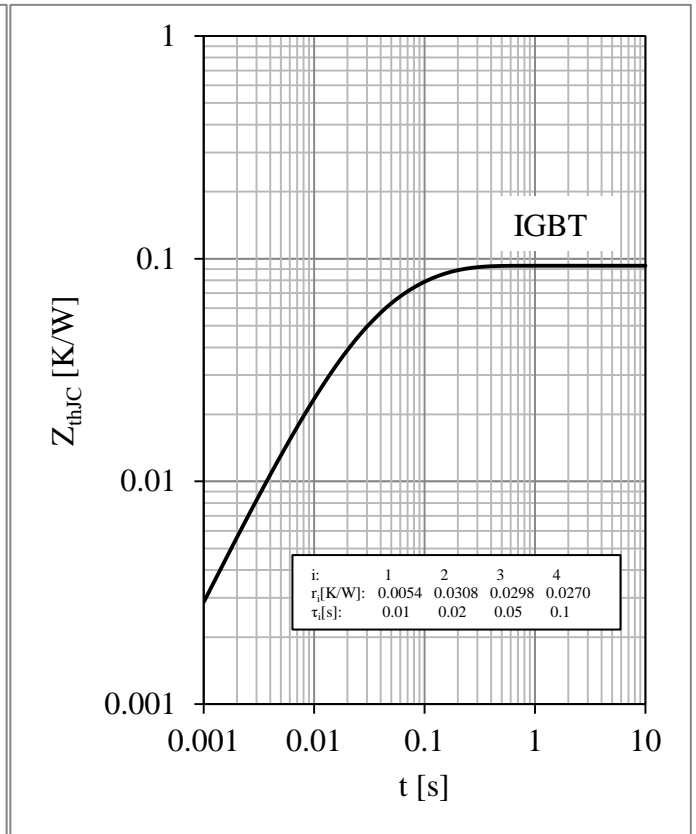


Fig 6. IGBT-inverter Transient Thermal Impedance

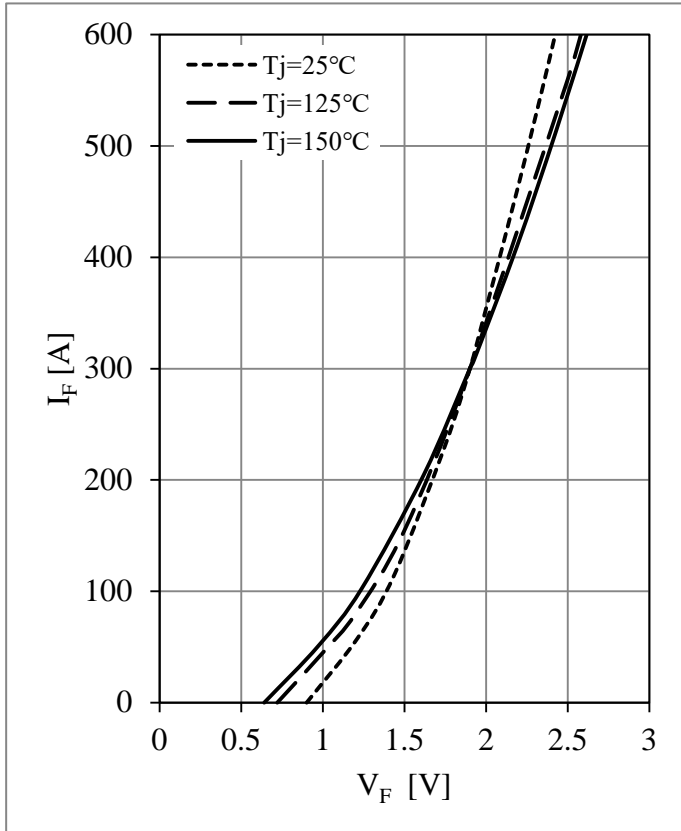


Fig 7. Diode-inverter Forward Characteristics

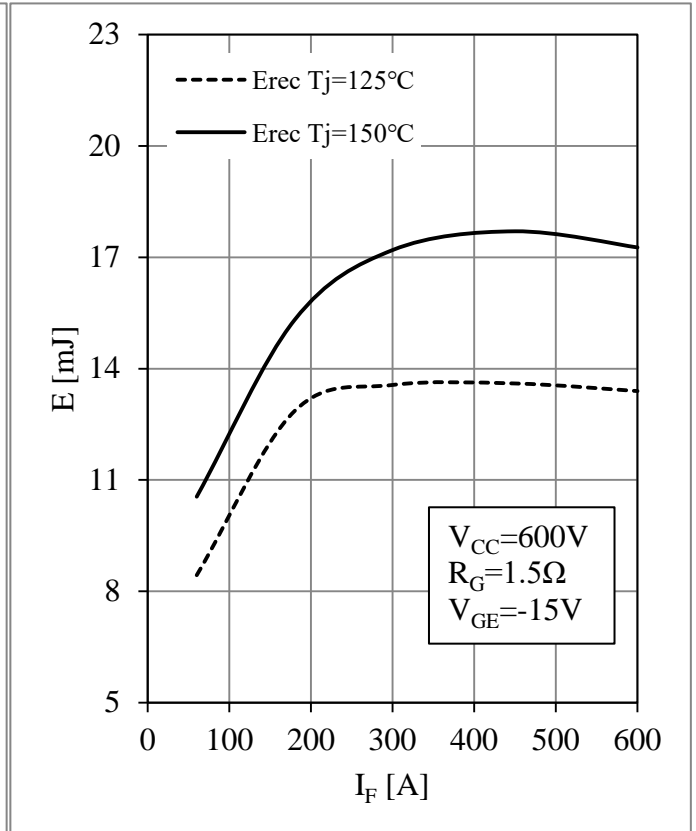


Fig 8. Diode-inverter Switching Loss vs.  $I_F$

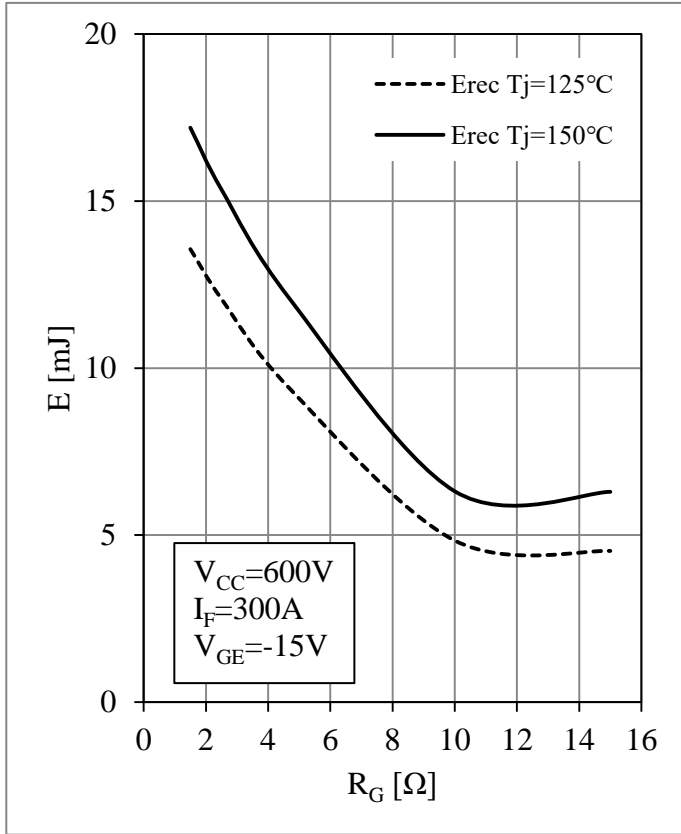


Fig 9. Diode-inverter Switching Loss vs.  $R_G$

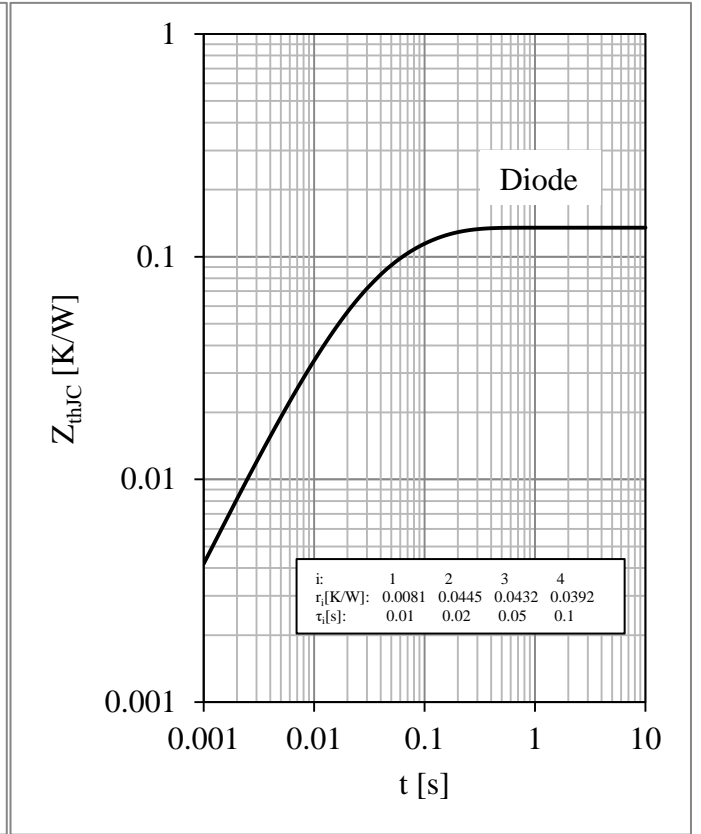


Fig 10. Diode-inverter Transient Thermal Impedance

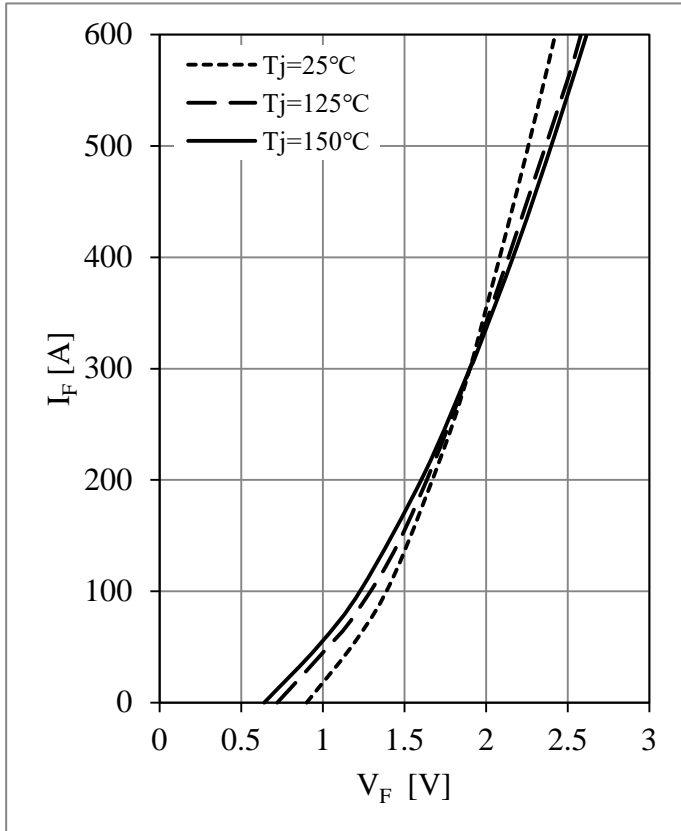


Fig 11. Diode-3-level Forward Characteristics

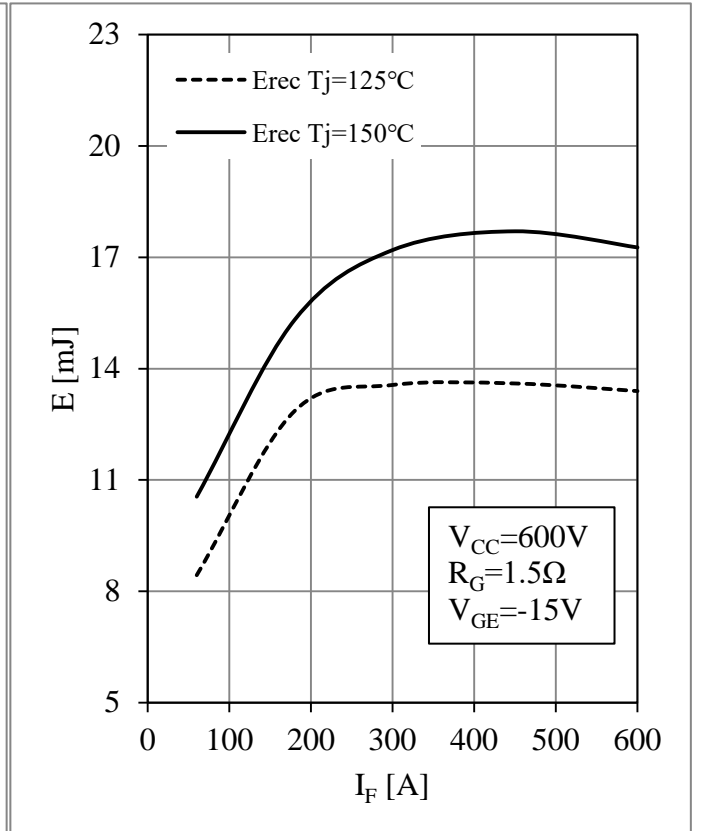


Fig 12. Diode-3-level Switching Loss vs.  $I_F$



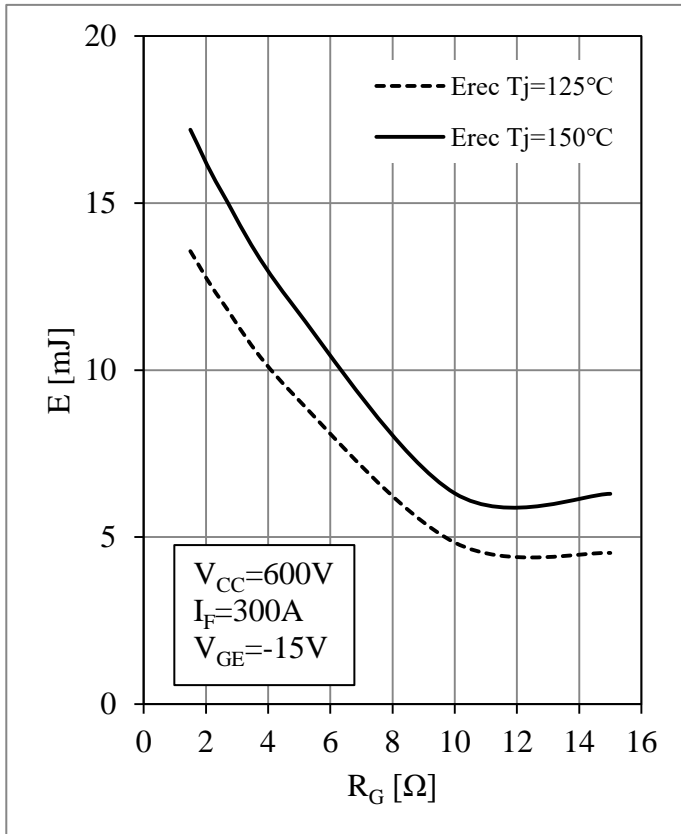


Fig 13. Diode-3-level Switching Loss vs.  $R_G$

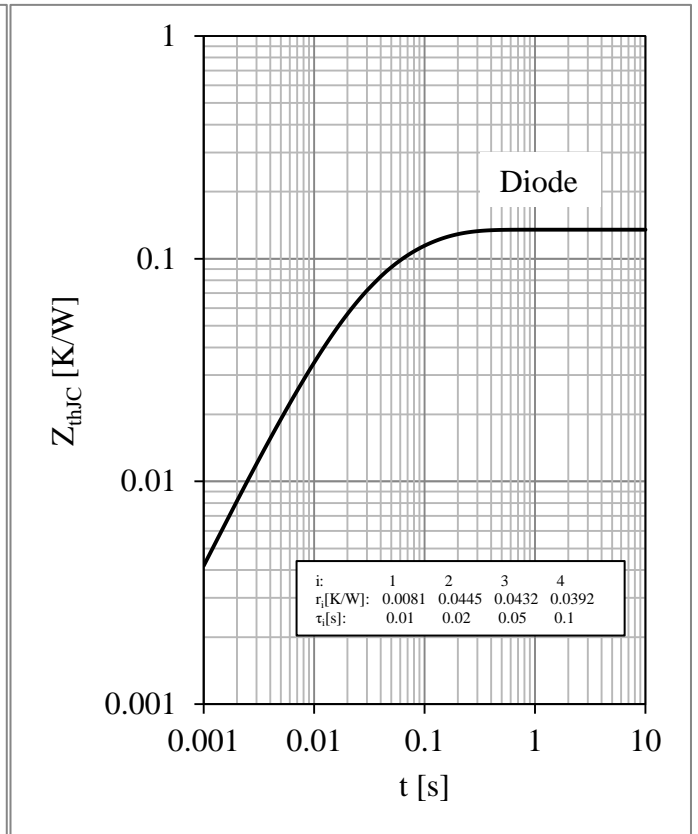


Fig 14. Diode-3-level Transient Thermal Impedance

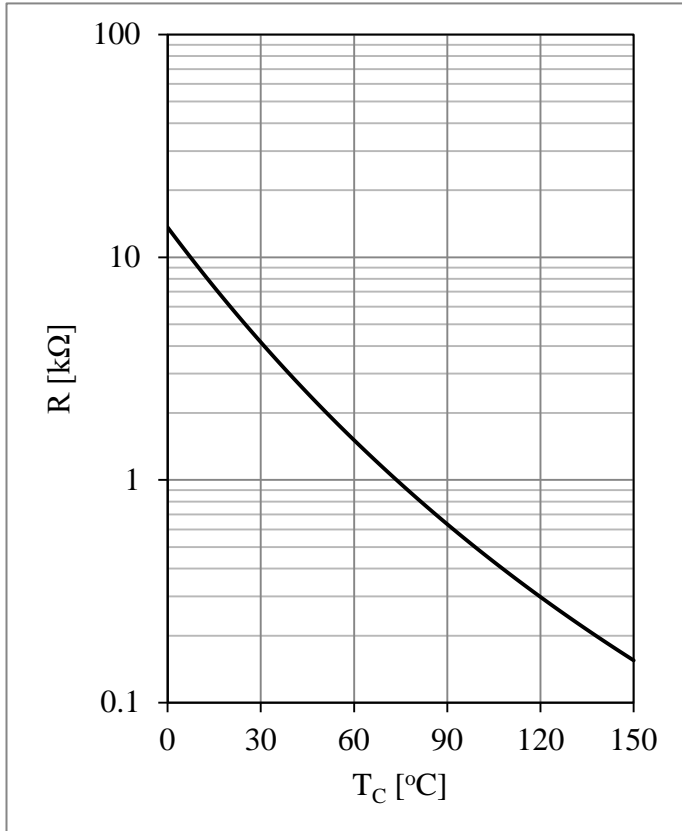
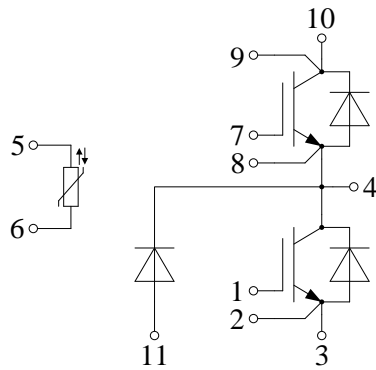


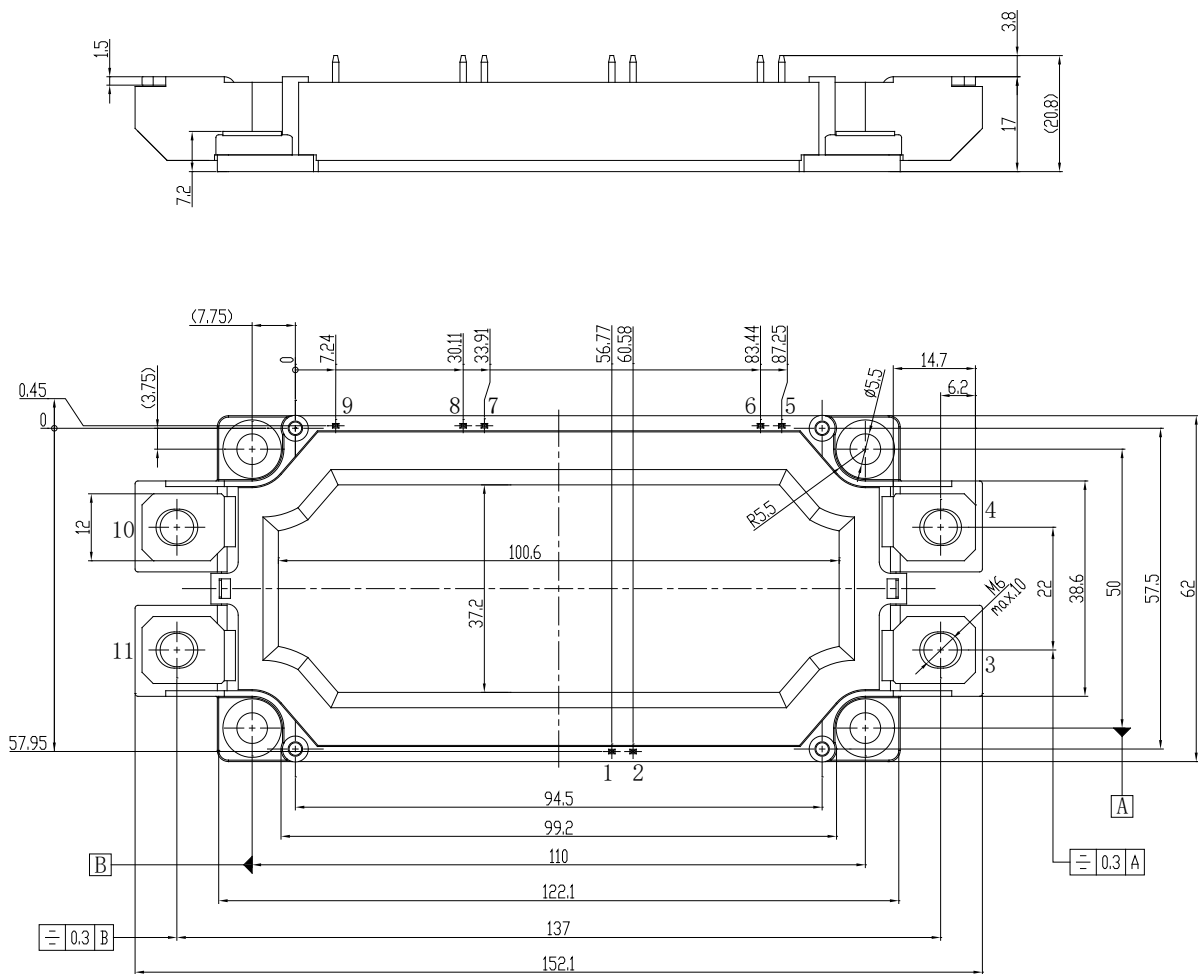
Fig 15. NTC Temperature Characteristic

**Circuit Schematic**



**Package Dimensions**

Dimensions in Millimeters



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